VOL. 5. No. 2. AUGUST, 1899.

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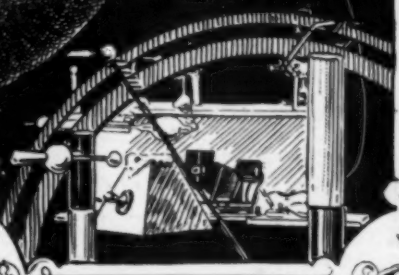
THE AMERICAN X-RAY JOURNAL

A MONTHLY DEVOTED TO THE PRACTICAL APPLICATION OF THE NEW SCIENCE AND TO THE PHYSICAL IMPROVEMENT OF MAN.



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New York City Business Office, 100 William Street, Room 205. PROF. T. L. BROPHY, Representative.
Chicago Business Office, 87-89 Washington Street, Room 514. DR. FRED W. SPINK, Representative.

SUBSCRIPTION RATES - IN ADVANCE.

United States, Canada and Mexico.....$1 00 | Foreign Countries.....$2 00
Single copies.....15 | Single copies.....20

Editorial matter should be addressed to Dr. Heber Robarts, Editor, 310 Chemical Building, St. Louis.

All business matter should be addressed to The American X-Ray Publishing Co., same address.

Contributors of original articles and other matter relative to X-Radiance, of interest to the medical profession, are solicited from all parts of the world. Contributors will be furnished a liberal number of extra copies of the JOURNAL containing their article. Reprints furnished by request.

Translation of articles written in German, French and Spanish is made by Frank Ring, A.M., M.D., 611 Chemical Building, St. Louis.

Entered at the postoffice at St. Louis, Mo., as second-class matter.

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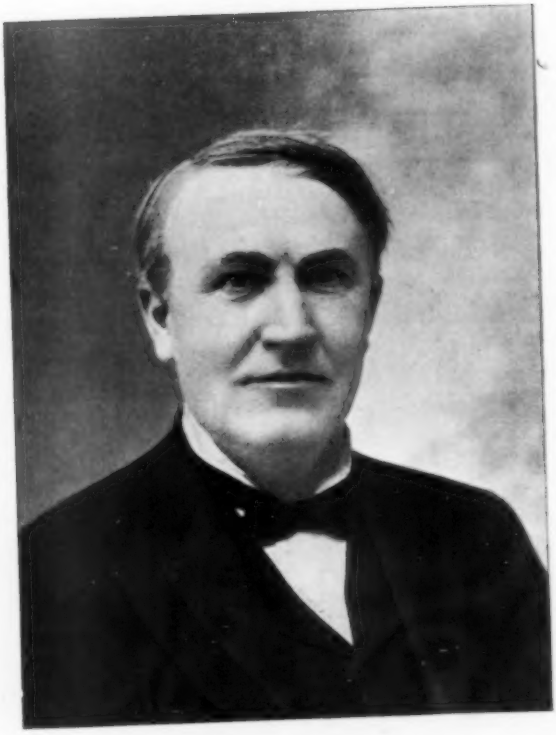


THOMAS A. EDISON.

The American X-Ray Journal.

Devoted to Practical X-Ray Work and Allied Arts and Sciences.

VOL. 5. ST. LOUIS, AUGUST, 1899. NO. 2.

The Ill Effects of Roentgen Rays As Demonstrated in a Case Herewith Reported.

This is the title of a paper read before the Medical Faculty of the County of Westchester, N. Y., May 1899, by Daisy M. Orleman, M.S., M. D. The article is reported in full in *The Medical Record*, and deserves to be read by physicians. It is the recital of a personal experience of a doctor who suffered so horribly so many months. It is probably the last great recorded act in a bugbear scare and will be remembered for this and because of its sensational nature and lucid description. Only the patient could have written so well. The imperceptible coming on of the insiduous injury, the full awakening to the realization of the impending disease, the hope of speedy recovery answered with oft repeated disappointment, the physical pain and mental anguish, the consultations, the going from place to place in futile search of a remedy reads with something of the same spirit that presses one on to read the personal experience of De Quincy and the Opium Habit.

Like the Bailing case in Chicago, many exposures were made of the man's injured leg, which was not in any way serious, in order to obtain an x-ray picture. In every instance there seems to have been failure. In each case the tube was near the unprotected flesh and the exposure of long duration. The first exposure was made in January, 1898, and the wounds which followed the repeated exposures lasting about two months, did not heal until near April, 1899.

After self inflicted medical advice proved useless the doctor consulted many physicians, surgeons, dermatologists and neurologists, notably Dr. W. T. Bull, of New York, Drs. W. N. Bullard, H. L. Burrell and Williams of Boston.

The remedies (?) used in the treatment consisted of alcohol, ointment of boracic acid, bichloride, lead, opium, ointment of zinc and lanolin, ichthyol ointment, balsam of Peru, castor oil, antiseptic solution, nitric acid, peroxide of hydrogen, aristol, nitrate of silver, cocaine, carbolic acid, sulphate of zinc, compound spirits of lavender water, hot bath, orthoform ointment, flax seed poultice, skin grafting, chlorinated soda wash, tincture of myrrh, rest and massage.

The doctor writes: A microscopic examination of a section of the tissues indicated a chronic inflammation characterized by a development of denser fibrous tissue in abundance. Infiltration of leucocytes in small numbers is seen through the fibrous tissue. The blood vessels were generally thickened and the lumina is narrowed as a result of the

thickening of the intima. The base of the ulcer is lined by a thin layer of necrotic tissue. Dr. Bullard, the Boston neurologist stated that the underlying condition was a destruction of the terminal nerve fibres a state of atrophic neurosis. The pain of an intense burning character was excruciating and a liberal quantity of cocaine combined with carbolic acid failed to give relief.

The writer concludes: "In the treatment of such an injury it is essential strictly to observe the therapeutic value of local rest. Had I given this precedence in the beginning, when I found that the case was not proceeding satisfactorily after the due application of poultices and stimulating washes, under which there was no local evidence of repair and the wound remained stationary, I might have had a more speedy recovery. There were obviously two requisites in the treatment which effected the cure in addition to the local applications: viz., to overcome the pain and to maintain the limb in a perfect state of rest. I found massage of the limb during the latter part of the treatment, twice daily, to be of inestimable value in maintaining good circulation."

The wise teachings of the great Hilton, written 25 years ago, "Rest and Pain," is too little heeded these tireless days; and the antiseptic and anodyne effect of electric currents too little known to be used.

Treatment of Lupus by Roentgen Rays.

By C. Thurston Holland, M. D., Superintendent of the X-Ray Dep't Royal Southern Hospital, Liverpool. Read before the Roentgen Society. Abstrac'ed from full text in *Archives of the Roentgen Rays:*

Dr. Holland has made a great many exposures to the x-rays and has taken 725 radiographs which he has kept. He has always used the simplest apparatus —an accumulator, a coil and a tube. The exposures have been from a few seconds to one hour. The distance of subject from the tube ranged between 4 and 14 inches without any attention whatever given to protect the body. No accident has come from the work not even the loss of a hair or redness of the skin.

The first case of lupus treated presented a chronic, irregular, punched-out tubercular ulceration of the foot which had lasted for upwards of eleven years. Walking was almost impossible as the foot was painful and the sore discharging freely. The usual treatment had been employed, together with scraping and caustics, with the unsuccessful results in such cases. All treatment was stopped except boracic ointment and the foot was exposed to the x-rays nineteen times within 58 days. A ten-inch coil was used and the tube placed 4½ inches from the foot with an average duration of exposure of fifteen minutes at each treatment. The first exposure was made April 18, and by May 24 the foot was much improved, and by the 31st all discharges had ceased. Jan. 14, when x-ray treatment was stopped, there was no pain nor discharge. The sore had not entirely healed and treatment was later resumed.

Case second is a boy of 16 years of age in whom a large lupus covered the left face and ear. It was of five years' duration. All the usual remedies and methods had been employed in vain. Seventeen exposures to the x-rays were made between April 18 and June 14, fifteen minutes being the average duration of each exposure. The platinum anode was kept red. After the eleventh application of the rays the lupus had mostly dried and the patient went about without any dressing. On Oct. 1, the boy was showed to the dermatologist of the Liverpool Medical Institute who pronounced the case cured.

The third case of lupus was in a boy of 18 and the ulcer had been on the face

eleven years. The variety was dry and did not yield to the x-ray treatment until several applications had been made and after full discharge had been established. After this the case improved.

The fourth case was a young woman in whom the entire face, nose and lips were involved in the lupus ulcer. It was of a malignant type. Scraping under chloroform and pure carbolic acid had been used. Rapid relapse followed each of these operations. She was not cured by the x-rays but was greatly benefitted. Dr. Holland is of the opinion that the x-rays stimulate the tissues in and around the diseased area which enables them to resist successfully the further spread and growth of the disease.

Photographs of the two first cases were made before and after treatment and are shown in the *Archives of the Roentgen Rays* for May.

Can Gallstones Be Radiographed?

Dr. H. H. Hogan examined *one* patient with the x-rays who presented symptoms of gallstones and found none according to *The New York Medical Record*. The doctor exposed six or seven gallstones to the x-rays and noticed but slight shadow; when in flesh he found them less opaque than the tissues would show about bone. One stone given him by Dr. Burchell, of the Belleview Hospital cast a decided shadow through hepatic tissue. This was supposed to be due to the excessive lime and less chlolesterine in the stone. However, Dr. Hogan thinks that the x-rays have no value in gallstones, his conclusions apparently being drawn from the one case cited. More than 18 months ago the writer distinguished gallstones in a patient, a woman 35 years of age. Dr. Schultz, of this city, happened to be in the office at the time and the doctor almost immediately recognized the shadow. Dr. Bernays accepted the radiographic and fluoroscopic diagnosis and without further inquiry operated. Several gallstones were removed and the patient made a happy recovery.

A Badly Treated Fracture.

Dr. W. D. Treavis, of Covington, Ga., in connection with an article read before the Medical Association of Georgia, April, 1899, showed a radiograph of the forearm of a girl nine years of age, which had been fractured two years before. The bones were put in apposition but the dressing consisted of bandages too tightly bound about the forearm and splints and too long retained causing curvature of the bones, union between the radius and ulna, sloughing, adherent skin, drop wrist and contracted fingers. Many months after the deformity was recognized the bones were separated and with the aid of electricity and massage the entire member has become quite useful. The forearm became somewhat dwarfed in all directions. The case is of interest to the surgeon using the x-rays because of the views that were made during the latter part of the treatment. Dr. Travis did not see the case until nearly two years after the accident.

Stone In the Kidney.

In the *Archives of the Roentgen Rays* for May, Mr. Mackenzie Davidson has had printed a radiograph of a stone in the right kidney which shows with remarkable clearness. The Crookes tube used had an osmium anode and the coil used gave a 10 inch spark. The tube was distant from the plate 15 inches, and two pictures made, the second with a tube displacement of 3 inches for localization purposes and to get a stereoscopic picture.

The duration of the exposure upon one plate was two minutes and twenty-six seconds and upon the other two minutes. The clear definition of the stone is due, according to Mr. Davidson, to exposing the plate only while the patient

was in the same phase of breathing. Motion like that attended with respiration blurs the picture. Three other cases are mentioned in this same connection in which the stone was easily seen and its exact location determined.

Colles' Fracture.

The radiograph was taken three months after the accident. Three physicians saw the case during treatment and united in the opinion that there was no fracture at the lower end of the radius. Some crepitation was distinguishable about the joint which was attributed to fracture of the styloid process of the ulna, and undoubtedly this was correct. The radiograph presents a distinct line of fracture across the distal end of the radius. This fracture was not attended with deformity. It was in a condition we frequently meet with in practice and often not appreciated—the parts being dressed as an ordinary sprain. Surgeons are familiar with the deplorable results of the practice resulting from failure of correct diagnosis in these cases. In this instance, fortunate for the attending doctors, their diagnosis confirmed crepitation which urged them to apply a permanent dressing.

Professor Horner, the radiographer, of Cleveland, Tenn., has made use of this case as an argument for the early employment of the x-rays in case of any fracture. From a surgical and medico-legal aspect the point is certainly well taken. If injuries were radiographed, when possible, before treatment and at the time permanent dressings were applied and again when the patient was discharged there would be less use of "physicians in the west," as mentioned in the *Journal of the Am. Med. Ass.*, of "owning no property, their home being in the wife's name

as a protection against suits for malpractice."

Bullet In the Pelvis.

A seven-year-old boy, of Spartansburg, Pa., was accidentally shot, by his brother, with a large caliber bullet. Probing was resorted to—the "Obsolete probe," "the accursed instrument," "the fatal probe," as it is variously called by the careful surgeon, with nil results. The boy was taken to Dr. Pitkin, of Buffalo, and the bullet located with the x-rays. The missile entered the left groin and stains or fragments from the lead indicates its course across the pelvis to the point of lodgment near the greater trocantar of the right thigh bone.

SURGEON MAJOR G. H. TORNEY, U. S. A., equipped the x-ray laboratory of the Hospital Ship Relief with the Dennis fluorometer, Surgeon W. M. Gray being in charge of the laboratory. W. G. Borden, Captain and Assistant Surgeon U. S. A., has placed this necessary adjunct to x-ray diagnosis, in the U. S. General Hospital at Washington.

.....

Doctors Trudeau and Baldwin, owners of the Saranac Lake Sanitarium, N. Y., have ordered a 16-plate machine for their institution. This is another evidence of the good management of the Saranac Lake Sanitarium.

.....

THE management of the Southern Pacific Railway has taken advanced steps in railroad surgery by supplying the Hospital at San Francisco with a 16-plate machine together with motor and all accessories.

.....

Dr. L. D. V. Judd of 3603 Pomelton Ave., Philadelphia, has put in his office a 16-plate machine.

.....

Dr. H. M. Schall, of Rochester, N. Y., Dr. Henry Chandler, of Baltimore, Md., and Dr. Eber W. Gurley, of Clevelsnd, Ohio, have recently put in their respective x-ray laboratories the Dennis fluorometer.

.....

Dr. H. W. Latham of Latham, Mo., has recently put in his office an 8-plate machine.

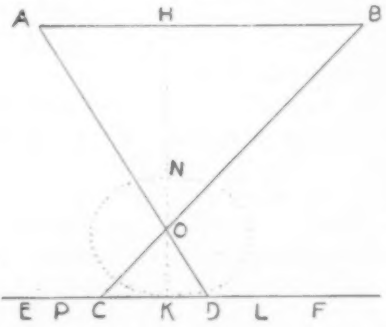
State College of Kentucky,
School of Physics,
LEXINGTON, Ky., July 21.

EDITOR AMERICAN X-RAY JOURNAL:

Dear Sir:—I send the following method that may be used in locating a bullet or other foreign object in the human body.

This method is readily understood by reference to the diagram.

Let the area enclosed by the dotted



line represent a cross-section of the human body or of that member of the body which contains the foreign object O. First let the position of O be determined approximately by photo or with the fluoroscope. Then with the body in position on the table E F, place the source of the x-rays at B, so that the shadow of O will fall at some point C on the photo plate P L. Protect the plate to the right of C, or from K to L, from the x-ray effect with a sheet of metal or a pane of glass; and use the rays until the shadow of O is fixed at C. Stop the current and shift the tube parallel with the plate to same point A. A B, the distance the tube holder is moved, can be accurately measured. Also move the sheet of metal until the plate is protected

to the left of D. Turn on the current and fix the shadow of O at D. After developing the plate, C D, the distance between the centers of the two shadows, can be accurately measured. Also measure H K, the perpendicular distance of the x-ray source from the plate. Then the distance of O from the plate is given by

$$O K = \frac{C D \times H K}{A B + C D}$$

The measurements required in the operation, C D, A B, H K, can be easily and accurately made. Care should be taken that the object O and the plate P L remain in the same positions while the exposures are being made.

This method is very accurate, though in some cases other methods might be preferable.

It will be observed that H N or K N can also be easily measured and the value of O N then determined.

This method may be used with the photo plate horizontal, vertical or oblique.

In some cases this method may be more satisfactory than to locate the object by finding intersecting lines with the fluoroscope.

Yours Truly,

M. L. PENCE, M. S.

108 Marino St.

VISIBILITY OF ROENTGEN RAYS.—Mr. Dorn, who has studied the effect of Roentgen rays on eyes, has recently made experiments with totally color-blind persons, the results of which are described in the "*Wied. Ann.*," No. 13, and abstracted briefly in the Lond. "*Elec.*" Feb. 3. One of them saw the Roentgen rays with an almost painful briliancy in the form of an elliptical ring. He concludes that only the rods on the retina, and not the cones, are sensitive to Roentgen rays. The experiments are claimed to show that the mechanism of perception for the Roentgen rays is practically identical with that for ordinary light.—Dorn. Lond. "*Elec.*"

ROENTGEN RAYS.

BY PROF. W. C. ROENTGEN.

If an opaque plate be arranged between the vacuum tube and a platinocyanide-barium screen, even pretty close to it, there is some fluorescence, which is cut off when the air situated laterally is sheltered from the impact of Roentgen rays by a thickness of lead. The effect is not due to the bending of rays; but the air, when struck by the rays, sends out Roentgen rays in all directions; so that if our eyes were sensitive to these rays, a vacuum tube would appear like a lamp in a room filled with tobacco smoke, and possibly the light from the tube and that from the air would have different colors, though there are at present no means of testing this question (whether the air acts by simple diffused reflection or as a quasi-fluorescent substance), for the rays from the air are also photographically active.

For comparative measurements the author uses a simple vertical plate of lead along the mid-line of a table; the fluorescent screen is placed at right angles to this, so that half the screen looks toward the left and half toward the right side of the partition. The two tubes to be compared are placed one on each side of this partition, and each then affects only one-half of the screen. In using this it is found that the tubes are very inconstant; they are sensitive to irregularities in the make and break (worse with Foucaults than with Deprez's contact breaker;) and when the outbursts of Roentgen radiation follow one another so rapidly that the eye cannot detect any want of continuity in the phosphorescence on the screen, the brightness of the screen depends on the intensity of a radiation from the platinum plate of the discharge tube, on the kind of rays reaching the screen, on the distance between the screen and

the tube, on the absorption undergone by the rays before reaching the screen, on the number of discharges per second, on the phosphorescent afterglow of the screen, and on the radiation to the screen from surrounding objects. From a flat plate the radiation is equal in all directions up to about 80 degrees from the normal, and the difference is only well marked at between 89 degrees and 90 degrees. The mode of experiment consisted in flexible photographic films bent to a half circle half surrounding the source; there is no ascertainable difference between the radiations at different angles; the photographic effect increases, except in extreme cases, with the angle between the source of rays and the photographic plate. There is an analogous case of equality in all directions in optical fluorescence. Drop fluorescein into water in a square tank illuminated by white or violet light, and the walls of the columns of the fluorescein solution appear the brightest, i. e., where the angle of emanation of the phosphorescence light is the greatest. Stokes has explained this through the fluorescence light being much less absorbed by the fluorescein solution than the exciting rays are. So here, the exciting cathode rays are much more absorbed by platinum than the induced Roentgen rays.

The sharpest shadows are obtained by tilting the platinum away from parallelism with the photographic plate through not more than 80 degrees; and the impression is then the most intense. In the absence of disturbing effect from the air, and on condition that the radiations remain of the same kind, the brightness of a fluorescent screen varies inversely as the square of its distance from the source.

Splitting a solid into layers makes no difference in its transparency; nor does putting it nearer to or farther from the screen. Rays which have traversed one thickness traverse another more readily (in proportion;) so that the specific permeability (fraction of radiation let through a layer of unit thickness) is greater the thicker the object. When two plates of different substances are equally permeable, this equality disappears if the plates are equally thickened or thinned; with plates of Pt. 0.0026 mm. and of Al 0.0299 mm. thick, one Pt = six Al; but two Pt = sixteen Al. Other similar numbers are given for other tubes. The relations between the equivalent thicknesses of two substances vary with the thickness and the nature of the material (e. g., the walls of the vacuum tube) traversed by the rays before reaching the screen. The author uses a platinum foil, 0.0026 mm. thick, with fifteen holes in it, closed respectively by single, double, . . . fifteen fold thicknesses of aluminum, each of 0.0299 mm. thickness. When this is interposed, a glance shows which thickness of aluminum is equal to 0.0026 mm. of platinum.

The corresponding number of aluminum thicknesses is called the "window number," the apparatus being called a "platinum window." Example: With direct radiations the window number was 5; on interposing 2 mm. soda glass, the window number became 10; the rays filtered through the glass found it relatively easier than before to traverse the aluminum. Rays sent through this platinum window and then through a dozen photoraphic films indicated the window number 10 for the first film and 13 for the last.

Conversely, one and the same substance is differently permeable to rays from different tubes; lowest vacua, least potential of discharge, "softest" tubes, least power of penetration; highest vacua, highest potential of discharge; "hardest" tubes, greatest power of penetration. With the former, window number say 2; with the latter may be

beyond 15. With the former, simple shadows of the hand; with intermediate exhaustions good bone shadows; with the last bones also permeable. With one and the same tube the quality and penetrating power of the rays depend upon the action of the contact breaker (which fluctuates), the length of spark gap paralleled to the tube in the secondary circuit, the introduction of a Tesla transformer, the amount of vacuum, and other uninvestigated changes within the tube itself. Putting a tube on the pump at the lowest sufficient vacuum, with small spark gap parallel to the tube, the tube is very "soft," the rays absorbable, and the window number small. Putting in a Tesla transformer, or a spark gap in series, the tube is "hardened." With a Tesla transformer in circuit, with narrow tube and wire electrodes, the rays are given off in air at 3.1 mm. Hg., and at still lower vacua in hydrogen.

The highest vacuum under which the rays can be given off is beyond 0.0002 mm. Hg. As the vacuum is increased, the spark gap must be at the same time lengthened; and when the tube is so "hard" that the spark gap has to be more than 20 cm. long, the rays will go through 4 cm. of iron. The tube will also become harder through its own continued action; so "hard" that a shadow photograph of a gunlock at 15 cm. distance can be taken in 12 minutes—a relatively long exposure, because the rays go through the photographic film instead of affecting it. This hardening is due to self exhaustion, and to some change in the electrodes themselves.

A tube, if too hard, can be softened by letting in air, by warming it, by reversing the discharges, or by driving very powerful discharges through it. In the last case, the necessary potential of discharge becomes high, but the rays are very absorbable and the window numbers low. It appears that the kind of rays emitted depends on the mode of discharge, however this may be attained. The same mode of discharge would give the same Roentgen rays, even at relatively high pressure. The quality of the rays is not affected by the strength of the primary current, assuming that the contact breaker acts equally at all current strengths; but their intensity is affected. Therefore, (1) the radiations from a tube are mixed, and differ in absorbability and intensity; (2) the composition of the mixture depends on the mode of discharge; (3) different rays are absorbed by different substances; (4) cathode rays resemble Roentgen rays in many respects, and the two discrepancies (a) difference of absorbability, and (b) the permeability to the two kinds of rays according to the density of the substance not following the same law, may be found bridged over by further researches leading to the discovery of rays of intermediate condition, say the Roentgen rays in ultra soft tubes and extremely thin windows, or the cathode rays in ultra-hard tubes.

Photographic results follow the fluorescent screen pretty closely, particularly with soft tubes; but with hard tubes the window number seemed a little lower than with a screen. When a hard and a soft tube bring the two halves of the fluorescent screen to the same brightness, a photographic plate put in place of the screen is less affected by the rays from the hard tube; in the latter the rays go through the film, and will go through 96 films and impress the last one while the first is scarcely overexposed. For this special reason, hard tubes require longer exposures; very soft tubes need longer exposures on account of their feebler intensity.

In a tube in action, Roentgen rays come not only from a minute area on the anticathode, but, more feebly, from the whole plate and a part of the walls of the tube. Cathode rays go in all direc-

tions from the cathode, but only feebly except along the axis. When the tube is hard and the platinum anticathode very thin, Roentgen rays start in considerable quantity from the back of the latter; and in very hard tubes the point which most emits Roentgen rays can be shifted away from the anticathode by a magnet.

Continued experiments show no difference in the permeability of any crystal according to the direction of the axis. It is the case that the eye can sometimes perceive the presence of Roentgen rays; this is due to the setting up of fluorescence in the retina; and with hard tubes, looked at through a narrow slit in a lead sheet, it is not difficult, by moving the slit, to get changing luminous figures. Nothing which may really be referred to diffraction has been discovered, though repeatedly sought for; apparent instances have all been found to be otherwise explicable.—*Electrical Engineer.*

THE ENERGY OF ROENTGEN RAYS.

BY DR. J. G. MCPHERSON, F. R. S. E.,
Science Examiner in the University of St. Andrews.

Since the marvellous properties of the Roentgen rays were discovered, very many experiments have been made to bear upon their application to physiology and surgery. Dr. Polland's Atlas of the development of the formation of the bones of the wrist from birth till seventeen years of age is one of the most startling of the recent successes of the process; and this has overturned to some extent the old theory of the formation of these bones.

There has been, however, as yet but little done to determine the *energy* of these rays. The Rev. Alexander Moffat, B.sc., has been studying the subject in Erlangen, and has submitted to the Royal Society of Edinburg the result of his investigations.

A. Rotti was the first to attempt to determine the duration of the Roentgen rays. He used a Ruhmkorff coil with a rotating interrupter to make and break the current in the primary circuit. On the interrupter he mounted a photographic plate, and in front of it had a screen of lead with a slit in it. The Roentgen rays were made to pass through the slit and make a photograph of it on the plate. From the amount of broadening of the photograph he found that the duration of a discharge was about $\frac{1}{600}$ second.

Dr. Trouton, of Liverpool, adopted the method of rotating a zinc-toothed wheel between the Roentgen lamp and the photographic plate. A photo of the moving teeth was secured by making one interruption of the primary current in the induction coil, thereby letting one discharge pass. The duration of the radiation was determined by the departure from sharpness of outline of the photo; and he concluded that the duration of a discharge was from $\frac{1}{800}$ to $\frac{1}{10000}$ second. M. Colandeau, adopting the same method, found the result to be about $\frac{1}{1000}$ second.

M. Morize adopted Rottis principle. He fixed the plate to one end of the axle of the electrometer, and at the other end he placed a toothed wheel which interrupts an electric current, and makes a contact which registers itself on a chronograph band. From the broadening of the image of the slit he found the duration of the discharge to be a little over $\frac{1}{1000}$ second.

Mr. Moffat has now determined that this figure is far too low. In fact he proves that the real duration is about a tenth part of that determined by Colandeau and Morize. He used an optical bank with a screen of barium platinocyanide and the Roentgen lamp at one end; an amylacetate lamp, as a source of light, being at the other end to note the standard of comparison. Between these was a movable photometer.

In order to obtain as strong Roentgen rays as possible, he introduced an air spark into the circuit, thereby driving away the particles of dust in the air and making the discharge more sudden. The Roentgen lamp and the spark interrupter were enclosed in a box, the lamp being fixed near one side. At the place where the rays from the anti-cathode were to be transmitted, a small hole was bored and covered with thin black paper. On the other side of this paper the screen was fastened. In front of the screen was fixed a piece of cardboard with a small hole in it, and through this the light-emitting surface of the screen appeared.

The light from the test lamp had to be weakened, because the light proceeding from the screen was very faint. This was done by putting the lamp inside a wooden box. A hole was made in front of the box and covered with translucent paper. In front of this was placed a piece of green glass. For a photometer he used simply two mirrors set at right angles to one another; in this way a very little of the light was lost. To determine the quantity of light emitted by the translucent paper from the amylacetate lamp, he put at one end of the optical bank a lamp, and at the other end the box with the translucent paper thus illumnated. He found that the light emitted by the paper was one-twentieth of that of the lamp.

He then removed the translucent paper and determined the extinction coefficient of the green glass by measuring the intensity of the light transmitted by them in comparison with that of the lamp alone. He found that the intensity of the light coming from the translucent paper, when weakened by transmission through the green glass, was about $\frac{1}{50000}$ lamp.

Now, the light of the lamp is emitted during the whole time it is burning, but the Roentgen rays only during very short intervals of time. To determine the upper limit to the duration of these intervals, Mr. Moffat put in front of the screen an opaque screen with a small vertical slit, and examined the image of the slit in a rotating mirror. The slit was three millimeters broad, and the mirror was exactly opposite it at a distance of 27-5 cm., revolving at the rate of about ten revolutions per second. Now, he saw that the image was broadened one-tenth part. Accordingly, the duration of a discharge must have been about $\frac{1}{2} \times \frac{1}{10} \times \frac{1}{10} \times \frac{3}{275} \times \frac{7}{44} = \frac{1}{120000}$ second.

By a series of successful experiments Mr. Moffat has averaged the duration of a discharge of the Roentgen rays at $\frac{1}{100000}$ second. This, at least, is the upper limit.—*Knowledge*, London.

Correction of Normal Divergence and Divergence By Position of The X-Rays.*

BY HEBER ROBARTS, M. D., ST. LOUIS, MO.
Editor of The American X-Ray Journal.

To be able to do useful x-ray work four surmountable barriers confront us; that is, four propositions that must be mastered before we should assume to make a positive diagnosis by the aid of the x-rays.

1. A generating apparatus and accessories capable of showing such things as the hip joint, tumors of the brain and the right and left heart.

2. The fluorometer, which, with mathematical precision, corrects distortion.

3. Knowledge of x-ray technique; knowledge of anatomy and pathology.

4. Ability to desynonomize and specialize the varying shadows on a screen.

The second proposition will occupy our attention at this time.

Prior to the public announcement of the discovery of the x-rays, Prof. Roent-

* Read before the Academy of Medicine, St. Louis, May, 1893.

gen had observed that the emanations from a Crookes' tube went on to infinity; but on leaving the tube this radiant energy diverged with constancy and with uniformity. At the Wuerzburg Physio-Medical Society in December, 1895, when the preliminary report of the discovery of the x-rays was made, it was very little thought that it would ever be used by the diagnosticians. As early as February of the following year, however, it was conceded by those acquainted with the subject that the x-rays had a permanent place in diagnostic medicine. It was already being employed to locate bullets and other foreign objects impervious to the rays. But when surgery was done, for the purpose of removing these opaque substances, the objects were found to be increased in size, and when far removed from the surface, so much distorted as not to be recognizable. Divergence, therefore, became a bugbear, and physicists everywhere were unsuccessful in devising means for its practical correction. This element of divergence we speak of as normal, because of its constancy and primarily emanating from the generating source.

At a single point on the platinum disk, where the cathode rays impinge upon the anode, is the source of the Roentgen rays, and at this point, the rays emerge, going out at an angle diverging thirteen-sixteenths of an inch in every sixteen inches of travel. If we have an object to examine, as for instance, a tumor of the brain, located in proximity to the Pineal gland, it will be distant from the fluorescent screen three inches. Then the tumor will have the appearance of being three-sixteenths of an inch larger than it really is. This defect in the picture may be sufficient in some instances to lead the surgeon into erroneous judgment, and preclude what might have been a safe operation. But with the fluorometric readings of today it is a simple matter of mathematics to determine the actual size of any body shadowed on a screen.

A greater difficulty which the surgeon had to encounter was the distortion occasioned by position. This condition made the diagnosis treacherous, uncertain and sure to misguide. The cause of this greater divergence was made more apparent by the discovery by Mr. Edison of the fluoroscope. An x-ray picture is a shadow without thickness on a fluorescent screen. The Crookes' tube is the emanating source of energy, as light is from a candle. The object to be seen must be interposed between this tube and the fluorescent screen. The shadow will be distorted precisely in the same manner as an object interposed between the candle and white wall. We can well recall the grotesque pictures we made on the wall with the fingers of the hands in childhood days or were made by grown persons for our amusement. They practically illustrate the errors possible in x-ray work of today, in the possibility of distortion—either designed or accidental. This element of divergence is said to be by position. It is really not a divergence but a distortion.

In the case of the tumor of the brain previously mentioned, divergence of the rays were shown to be unalterable and, therefore, the size of the object easily calculated. Now it is necessary to locate the tumor with precision, if diagnosis and surgery are needed. If the body is fixed the object will appear to be fixed also; but the slightest rotation will shift the shadow and change its outline, giving the appearance of fixation at another site. This movement can be effected at will. Should the object to be examined lie near the screen, rotation of the body will not be attended with very great distortion; but greatly so, if far removed.

It is in this manner that erroneous opinions have become current; to the

effect that a sound bone may be made to appear fractured and a fractured bone sound. In neither of these cases can this be done unless some extraneous device is employed. Fractures and dislocations can, however, be made to appear grossly exaggerated, or such malcondition may be made to appear in almost normal position. An operator ignorant of anatomy and of the principles of divergence and distortion may do either of these innocently. This is a vital point on which medico-legal cases will hinge.

It became apparent that unless distortion by position and normal distortion could be corrected it would be unsafe to employ this means in diagnosis for the surgeon and worthless, if not dangerous, in courts of law. In the spring of 1897 Mr. Dennis, of New York, conceived of a method wherein the parallelism of the x-rays could be effected, and made the device to this end for practical purposes. Mr. Puffer, of the same city, called the device a fluorometer, because it measured the shadow on a fluorescent screen.

The fluorometer consists of right angle devices impervious to the x-rays, together with wooden supports and an adjustable table. It provides:

First, a perfect shadow, when thrown on a screen or sensitive plate.

Second, elimination of the distortion resulting from radiant energy known as the x-rays.

Third, the normal distortion and distortion by position having been eliminated, the fluorometer provides an accurate cross-section of the body and supplies an absolutely correct right angle, at the intersection of the lines of which the foreign object will be found in the body.

As a final conclusion it may be stated that without the evidence of a fluorometer having been used, clearly shown by its own shadows in the radiograph, no x-ray picture should be admitted as evidence in any court.—*American Journal of Surgery and Gynecology.*

TRANSLATIONS.

BY FRANK RING, M. D.

Revue Internationale d' Electrotherapie et de Radiographie, Paris, publishes an interesting index of progress in x-ray work, from which the following points have been selected:

Radioscopy of the Lungs; the Danger of Misinterpretation by Those Who Employ This Method of Diagnosis (Abrams) Phila. M. J.

A Discussion on the Uses of the Roentgen Rays in Ophthalmology. (British M. J.)

A Case of Nephritic Stone Diagnosticated by Means of the X-Rays, and found upon operation (*Munch Med. Woch.*) Alsberg.

Upon the Treatment of Lupus and Chronic Eczema with the Roentgen rays (Albers Schoenberg) (*Forscher, a. d. Geb d Roentgenstr, Hamb.*)

Surgical Applications of Radiographie, by Jeannel Marie (*Arch Prov. de Chir.*)

Gunshot Wound of left Kidney; Immediate Laporotomy; Secondary Radiography and Extraction of the Ball; Perineal Drainage; Preservation of the Organ; Recovery. (*Gaz. de Hop*, Paris.)

Chronic Tubercular Peritonitis, which had been treated without results, by the usual methods; Radiotherapy; Recovery. (Ausset et Bedart, in *Bell d. l. Soc. Centr. d. Med. du. Nord. Lille.*)

Roentgen Rays and the Diagnosis of Tuberculosis. (Beclere, in *Bull. Med.*, Paris.)

Roentgen Rays and the Displacement of the Left Pleura. (Beclere, in *Bull. et Mem. Soc. Med. d. Hop d Paris.*)

The X-Rays in Spina Bifida. (Beck, in *Med Recr.* N. Y.)

Upon the Changes in the Skin Arising From the Influence of the X-Rays. (Behrend, in *Berl Klin Wochenschr.*)

A Bullet in the Brain, Located by the X-Rays. (E. Von Bergman, in *Arb. a. d. Chir. Klin. d. k. Unir*, Berlin.)

Effect of X-Rays Upon Tuberculosis. (Bergoine et Tessier, in *Arch d Elect. Med.*, Bordeaux.)

New Measuring Apparatus for the Roentgen Rays. (Biesalski, in *Ann. d' Electrobiol*, Paris.)

Case of Removal of Bullet From Body of the Axis After its Location by Skiagraphy. (Bird, in *Intercolon.* M. J. Melbourne.)

Acquired Oval Oblique Pelvis; Radiography. (Bonnaire, in *Bull Soc d' Obst de Paris.*)

The Roentgen Rays in the Diagnosis of Pulmonary Tuberculosis. (Bouchard and Claude, in *Am. X-Ray J.*)

Wound in the Eye by a Grain of Lead; Recognition of the Projectile by Radiography. (Bourgeons, in *Un Med. du Nord-Est*, Reims.)

A Case of Gunshot Wound of the Brain. Removal of the bullet after recognition of its site through radiography, together with general remarks upon the treatment of gunshot wounds of the head. (Von Burkhardt, in *Med. Corr. bl. d. Wurtemb.*)

The Movements of the Stomach Studied by Means of Radiography. (W. B. Cannon, in *Porton Med.*)

[CONTINUED.]

The American Electro-Therapeutic Association.

With the near approach of the annual meeting of the American Electro-Therapeutic Association, to be held on September 19, 20 and 21, in the city of Washington, under the Presidency of Dr. F. B. Bishop, the Local Committee of Arrangements is redoubling its efforts to make it a success. Many electrical manufacturers will be represented in the Exhibit Hall, and information will be freely given. Papers have thus far been promised from Drs. R. G. Nunn, A. D. Rockwell, Margaret A. Cleaves, F. J. Leviseur, Walter White, Robert Reyburn, G. A. Carson, C. O. Files, J. H. Kellogg, John A. Licthy, W. W. Scheppegrell, L. Howe, E. Wende, F. B. Bishop, Robert Newman, W. J. Herdman, G. B. Massey, and Profs. Bergonie of Bordeaux; Apostoli and Dolbear of Paris.

With such authors a successful meeting must result.

LLEWELLYN ELIOTT, M. D.,
Press Committee.

PROF. A. C. BERNAYS, of St. Louis, Mo., has resigned his chair in the Marion-Sims College of Medicine, and will devote three and one-half hours each day in the future towards teaching practical surgery to private classes of graduates in medicine.

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